What Fuel Conservation Means to America

By Robert W. Woolley
Member of the Interstate Commerce Commission

AMERICA is confronted squarely with the problem of increasing her productivity per man power without, at least, increasing the cost of production per article. This in addition to any economies that may be effected through national obedience to the slogan "Produce more, save more and waste less." Such increased productivity per man power must come about through more efficient utilization of fuel, water power and machinery. I propose in this article to deal specifically with conservation of the two great articles of fuel—coal and petroleum—and more particularly with coal, for scientists agree that the days of petroleum as a commercial factor are numbered.

From *The Energy Resources of the United States: A Field for Reconstruction*, by Chester G. Gilbert and Joseph E. Pogue, volume 1, bulletin 102, of the Smithsonian Institution (United States National Museum), I quote as follows:

> While it is commonly known that our present utilization of fuel is wasteful, it is not generally appreciated how very serious and extensive this default has become, how many lines of progress the current practice in this field is blocking, and how distinctly and heavily the whole matter is contributing to the cost of living. While the color of sensationalism is to be deprecated, the assertion cannot be avoided that this country has within its reach the means for effecting a saving in the matter of its energy supply of well over a billion dollars a year. * * * In this one direction alone lies a gain sufficient to recoup much of the expense of the Great War.

Decline of Petroleum and Oil Supply

Referring to petroleum, Messrs. Gilbert and Pogue say:

> The liquidity of the crude product makes petroleum unique among mineral raw materials, contributing wide commercial availability through the ease with which the substance may be mined and handled; while the magnitude of the resource has given confidence for the extensive mechanical developments essential to its use. Hence the employment of petroleum is deeply rooted among the practices and needs of modern life, and any tendency toward disuse of its essential products, either through undue increase in price or from decline in production, will mark a turning point in material comfort and industrial advantage, the deferring of which becomes an object of universal concern. As the petroleum deposits of the United States have been drawn upon with extraordinary rapidity and the supplies have already suffered serious depletion, the matter of their approaching exhaustion assumes the light of immediate importance. The comforting assertion that such considerations may be safely left to future generations does not apply to petroleum.

In a recent widely published statement, E. Mackay Edgar, a noted English authority on oil, predicted that in ten years the British Empire will be selling 500,000,000 barrels of oil annually to the United States. Estimating the value of this oil at $1,000,000,000, he asserts it will be the means of restoring and maintaining sterling equilibrium. He said: "More oil has probably run to waste in the United States than has ever reached the refiners. Improvidence, carelessness, a blind gambling spirit, have marked all except the most recent phases of the industry. The great oil fields of the United States are nearing exhaustion, and it is not believed the new ones which are being proved will yield anything like the old prodigal production. America has recklessly, and in sixty

years, run through a legacy that, properly conserved, should have lasted her for at least a century and a half."

In other words, some fine morning not so far distant we are to awake to the realization that we have exhausted one of our principal sources of industrial greatness ninety years ahead of time, because as a nation we have felt it was unsound for the government to interfere in any degree with private enterprise—to curb the get-rich-quick promoter or speculator in the interest of all the people. As long ago as 1915, Secretary of the Interior Lane said in his annual report: "Petroleum is a priceless resource, for it can never be replaced. Trees can be grown again upon the soil from which they have been taken. But how can petroleum be produced? It has taken the ages for nature to distill it in her subterranean laboratory. We do not even know her process. We may find a substitute for it, but have not yet."

THE PROBLEM OF COAL CONSERVATION

True, we are equally reckless in the mining and handling of our coal. In their report just referred to, Messrs. Gilbert and Pogue say:

> In spite of ample supplies in the ground, coal inadequately meets its obligations because of the competitive manner in which it is mined, the unnecessary extent to which it is transported, and the improper way in which it is used. The first has caused tremendous waste, the results of which will be felt heavily in the near future; the second has caused a coal shortage during the war and promises a repetition at every coming period of sudden industrial expansion; the third has imposed an excessive burden of cost upon the public. To prevent waste, to circumvent shortage, and to lower cost, changes in our system of coal economics are necessary. These changes must be determined by coal itself—by the nature of its geographic distribution, geologic occurrence, mining technology, and chemical composition.

The problem may be largely solved by coking our high volatile bituminous coals.[1] A process by which this may be done is one of the by-products of the war. The results of the government test of this process, held under the joint auspices of the Bureau of Standards and the Bureau of Mines, were not deemed by the War Industries Board to be sufficiently convincing to warrant its adoption as a means of increasing the production of benzol and other coal products necessary in the manufacture of high explosives, but upon favorable reports made by such distinguished scientists as Dr. Alex. C. Humphreys, president of the Stevens Institute, Mr. Alex. H. Twombley, a noted coke engineer and Mr. Y. Iwamura, coke expert of the Japanese government, private capital has undertaken its exploitation on a large scale. Since the signing of the Armistice, I am informed that a 10,000,000 yen company has been formed at Tokio, by the Industrial Bank of Japan, acting for the government, and that the construction of ovens in Japan and her dependencies on the mainland of Asia, is about to begin.

The first battery of ovens of formidable size is now being erected at Granite City, Ill., ten miles out of St. Louis at an estimated cost of $15,000,000, and other batteries equally potential are planned at points in the heart of the soft coal regions—Jackson, Ohio, for instance—at such steel manufacturing points as Cleveland and at tidewater—for example, Bridgeport. It

[1] The beehive oven, which produces only coke, and the by-products ovens of German and Belgian design heretofore in use have only coked successfully the so-called, low-volatile, bituminous coals, which represent about 5 per cent of our coal supply and are to be found largely in the Connellsville, Pocahontas and Birmingham districts.

is only reasonable to suppose that in the not far distant future there will be other radical developments along this line. Now that the ice is broken and the possibilities are so glittering we we may expect science to "carry on" at a rapid pace. One writer, in his enthusiasm, speaks of the invention of the new by-product oven as being even more important than was the advent of the sewing machine or the cotton gin. Time may prove this to be true.

Waste in Production.—Referring to the production of coal, Messrs. Gilbert and Pogue say:

> It is wastefully used due to the lack of by-product recovery as an accepted economic practice. * * * The wastes in distribution may be reduced through the development of hydro-electricity and the coal-field generation of carbo-electric power, thus relieving coal of unnecessary duties, and by improvements in utilization, thus destroying the over-dependence upon high-grade coals which now necessitates undue haulage.
>
> The wastes in utilization may be done away with by establishing a method of separating the energy-producing constituents of coal from the commodity values and using the products to their common advantage. The most logical point of attack is the municipality, to which may be attached a public utility plant converting raw coal into smokeless fuel—artificial anthracite plus gas, or gas alone—and valuable by-products, ammonia, benzol, and tar. Such a plant would supply the fuel needs of the community and ship the surplus by-products to serve as raw material for a coal-products industry, developed thereby to proportions consistent with its importance to social progress. * * *
>
> By-product utilization will give cheaper fuel through the advantageous disposition of all the values contained. It will also end the smoke nuisance, relieve transportation, and cause the growth of a great coal-products industry with ultimate possibilities ranging beyond the grasp of the imagination.

I have quoted liberally from high scientific authority because when the railroads were first taken over by the government I was asked by the director general—each member of the Interstate Commerce Commission undertook some special investigation looking to the working out of various phases of the railroad problem—to conduct an inquiry into the question of fuel economy. The serious difficulty encountered was lack of uniformity as to quality of fuel consumed in locomotives. I concluded that if it were practicable the burning of powdered coke offered the solution. Accordingly, at my request President Wilson directed the test of the new by-product oven referred to above. The results so far as the proposed burning of powdered coke was concerned were not satisfactory, but that was really of minor importance when one considers the big result—that most of our high volatile coals are available for the manufacture of metallurgical and fuel coke and the extraction of valuable by-products.

RESULTS OF COKING OUR COAL SUPPLY

The use of this new process is fraught with "ultimate possibilities ranging beyond the grasp of the imagination." Some of the potential results are:

1. That the amount of coal in the country from which metallurgical coke can be made is increased from 5 per cent of our available coal supply to between 40 and 50 per cent of this supply, or a net increase of between 800 and 1,000 per cent; this makes available for the manufacture of pig iron and steel many low grade ores now regarded as having a negligible value only because of their remote location from recognized coking coal regions.

2. That all coal now used by railroads, except anthracite, which nature has coked, can be coked and from the sale of the by-products the cost of production, including the price of the

coal, largely defrayed, thus making the coke obtained practically net; that in due time all railroads may be advantageously electrified.

3. That the enormous banks of culm, accumulated through the many years of mining anthracite coal and long regarded as so much waste, may be mixed with the high volatile coals which intersperse the anthracite region and coked for fuel at the banks or at the mines, thus adding very materially to the fuel supply in the coal region closest to the great industrial centers of the eastern and northeastern parts of our country.

4. That by coking all bituminous coal, low and high volatile, the total amount of which mined in 1917 was in round numbers 612,000,000 tons and using the same figures for 1918 for purposes of calculation—value at the mines, at $3.50 per ton, $2,142,000,000—there would have been produced:

(a) 437,144,400 tons of coke having f. o. b. market value, using standard quotations of $6.00 per ton Connellsville, of $2,622,866,400.

(b) By-products having f. o. b. market value of $3,213,000,000.

(c) There would be a net saving in natural resources, allowing $4.89 per ton of coke for coal used and cost of manufacture, of $3,698,230,284 as compared with $109,742,799, the estimated net profit on 19,059,361 tons of eokc made in by-product ovens in 1917 from 26,683,105 tons, the total amount of coal coked that year in by-product furnaces; in a word, last year we wasted $3,588,487,485 in natural resources through coal alone.

5. That the annual gasoline supply—fine oil recovered from coal is its like, but estimated to be 28 per cent superior—would be increased by 48,624,110 barrels; our total production of gasoline in 1917 was approximately 27,000,000 barrels. This means cheap fuel for tractors, trucks, automobiles and aeroplanes.

6. That the total gas supply of the country, on the basis of 6,000 feet per ton of coal, B. T. U. 560, would be increased to 3,672,000,000,000 cubic feet, having a basic or at-the-mine value of 10 cents per 1,000 cubic feet, or $367,200,000. This, of course, could be piped any necessary distance.

7. That through the recovery of light oils and of 12 gallons of tar per ton of coal made, or 7,344,000,000 gallons annually, having a present at-the-mine value of $367,200,000, we would become the greatest nation of dye, drug and chemical producers in the world.

8. That the 18,360,000,000 pounds of ammonia sulphate—30 pounds per ton of coal—produced annually would so augment our fertilizer supply that our soil could be made to increase enormously in productivity per acre and would afford an abundance of an important ingredient of high explosives.

9. That the production of toluol, from which trinitrotoluol (T. N. T.) is made, would be increased enormously.

10. That there would be attributable to coal smoke no further reduction in the creative producing power of our people, estimated in the report on smoke abatement by the Chicago Association of Commerce to be $1,000,000,000 annually, and that at least $100,000,000 in paint and repair work, due to the ravages of acids and the destructive effect of coal smoke, would be saved each year. Every town and city in the United States could be made clean and kept clean.

11. That through cheap power our productivity per person would be so considerably increased that we would be able to pay higher wages and with our great merchant marine, once we are back to normal conditions, we could market our manufactures at a profit

even in countries having the cheapest labor.

12. That our national wealth would be so augmented eventually through the greatly increased value of our high volatile coals, now used for high grade purposes, that the cost of our participation in the war would be almost, if not quite, absorbed.

13. That by making possible the transmission of all power, light and heat from the pit heads of the mines, at a cost below any yet suggested, the saving in domestic labor and in personal inconvenience would be incalculable and poverty abolished or at least reduced to a very low minimum; that thousands of individual industrial power plants, so costly to operate, would be scrapped or used for power distribution.

14. That through natural processes the three greatest of our monopolistic groups—oil, steel and power—would, with the government owning and operating the super-power stations, be effectively and permanently broken up. So, among other things, the prospective loss of gasoline produced from petroleum is to be more than offset by benzol. That answers Secretary Lane's question in large measure.

THE NEW COKE OVEN AND THE ELECTRIFICATION OF RAILROADS

In my report to the director general of railroads on possible fuel economies, submitted eleven months before the work of Messrs. Gilbert and Pogue, from which I have quoted so liberally, was issued, I featured the test of the new coke oven and called attention to the generally admitted fact that our railroads must in the near future be electrified. I quote in part as follows:

> The super-power station would entirely eliminate the transportation of coal for power purposes and would relieve the railroads of the congestion caused thereby. This is more than half of all the coal used in the country. The amount of fuel needed to generate a unit of power in the super-power station would be much less than that required by our present local plants. Besides, the freight cost would also be saved; this is more than half of the coal item in present costs of power generation, and coal is by far the largest single item of cost. There are still other items of cost for power which would be reduced in the super-power station.
>
> It is generally conceded that the electrification of steam railroads is imminent, but that the capital required for the generating plants and transmission lines is the chief present deterrent. The super-power plan would make the electrification of the steam railroads to a large extent possible at an early date, at least very soon after the conclusion of peace, when the copper needed for transmission lines is likely to be plentiful and cheap. It would increase traffic capacity from 25 to 50 per cent, would increase speed in transportation, and would practically eliminate railroad congestion, particularly during the winter season. It would entirely eliminate the transportation of coal for use by the railroads themselves.
>
> The advantages to be secured through the electrification of steam railroads are many:
>
> An electric locomotive will handle twice the load of a steam locomotive.
>
> It operates best in cold weather when a steam locomotive has its greatest troubles.
>
> On down grades what is known as regenerative braking returns from 25 to 50 per cent of the power used in climbing. This power is returned to the lines for the use of other locomotives climbing other grades. Regenerative braking is separate from air brakes, which are only used in emergency and in stopping a train. The trains run down any grade under perfect control, better in every way than by the use of grinding brakes, and at the same time electric current is being generated and returned back into trolley wires to assist in running other trains.
>
> An electric locomotive can be operated over a thousand-mile run in mountain work with only casual inspection. A steam locomotive for the same service requires close attention and makes it necessary to maintain round houses and yards at frequent intervals. Most of these can be eliminated by electrification.

Electrification is the cheapest and most practical means for producing an increase in traffic capacity. There are three ways for producing this increase: first, additional tracks; second, elimination or reduction of grades; third, electrification.

The entire cost of electrification, including the power stations and transmission lines, is less than the cost of either additional tracks or the elimination or reduction of grades. By electrification the traffic capacity can generally be increased 50 per cent over what it is with steam locomotives. The electric locomotives go over the steepest grades with only a comparatively slight reduction in speed.

The electrification of the railroads would better the load conditions on the super-power stations, and this would tend to still further reduce the cost of generating power.

Military experts agree that if there is ever another war it will be waged largely with gas. Scientists are saying that the nation developing the greatest dye industry, with its necessarily large complement of chemists, will be best prepared. This was the foundation upon which Germany built. In the limited space allotted me it is impossible to go even into meager details as to the possibilities of the dye industry. The point is that we are destined to lead the world as dye makers. I have not even touched upon the proper and logical development of our water power. That is a subject on which so much has been written that I have deemed it my duty to deal almost exclusively with what seemed to me to be the urgent and striking phases of the problem of conserving and efficiently utilizing our coal. If we are prudent, it is practically inexhaustible—and, thanks to the by-products process, is the source of the cheapest heat, light and power.